

**Publication****New type of evidence for secondary ice formation at around -15 °C in mixed-phase clouds****Journal Article (Originalarbeit in einer wissenschaftlichen Zeitschrift)****ID** 4516958**Author(s)** Mignani, Claudia; Creamean, Jessie M.; Zimmermann, Lukas; Alewell, Christine; Conen, Franz**Author(s) at UniBasel** [Conen, Franz](#) ; [Mignani, Claudia](#) ; [Alewell, Christine](#) ; [Zimmermann, Lukas](#) ;**Year** 2019**Title** New type of evidence for secondary ice formation at around -15 °C in mixed-phase clouds**Journal** Atmospheric Chemistry and Physics**Volume** 19**Number** 2**Pages / Article-Number** 877-886

Ice crystal numbers can exceed the numbers of ice-nucleating particles (INPs) observed in mixed-phase clouds (MPCs) by several orders of magnitude, also at temperatures that are colder than  $-8\text{ °C}$ . This disparity provides circumstantial evidence of secondary ice formation, also other than via the Hallett–Mossop process. In a new approach, we made use of the fact that planar, branched ice crystals (e.g. dendrites) grow within a relatively narrow temperature range (i.e.  $-12$  to  $-17\text{ °C}$ ) and can be analysed individually for INPs using a field-deployable drop-freezing assay. The novelty of our approach lies in comparing the growth temperature encoded in the habit of an individual crystal with the activation temperature of the most efficient INP contained within the same crystal to tell whether it may be the result of primary ice formation. In February and March 2018, we analysed a total of 190 dendritic crystals ( $\sim 3$  median size) deposited within MPCs at the high-altitude research station Jungfrauoch (3580 s.l.). Overall, one in eight of the analysed crystals contained an INP active at  $-17\text{ °C}$  or warmer, while the remaining seven most likely resulted from secondary ice formation within the clouds. The ice multiplication factor we observed was small (8), but relatively stable throughout the course of documentation. These measurements show that secondary ice can be observed at temperatures around  $-15\text{ °C}$  and thus advance our understanding of the extent of secondary ice formation in MPCs, even where the multiplication factor is smaller than 10.

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